

The Nearctic Species of *Protarchus* Foerster (Hymenoptera: Ichneumonidae: Ctenopelmatinae)

LUC LEBLANC

Eastern Cereal and Oilseed Research Centre, Agriculture and Agri-Food Canada, Ottawa,
Ontario, K1A 0C6, Canada

Abstract.—The Nearctic species of the Holarctic genus *Protarchus* Foerster (Ichneumonidae, Ctenopelmatinae, Mesoleiini) are reviewed. A key to the Nearctic species is provided. Seven species are recognized. *P. testatorius* (Thunberg) and *P. sorbi* (Ratzeburg) are Holarctic, *P. bolbogaster* Leblanc, n. sp. and *P. mellipes* (Provancher) are transcontinental Nearctic, *P. magnus* (Davis) and *P. pallidicornis* (Walley) are eastern Nearctic, and *P. atrofacies* Leblanc, n. sp. is found in Alaska. The name *P. longipes* (Cushman) is synonymized with *P. sorbi*, new synonymy.

The Holarctic genus *Protarchus* Foerster belongs to the ichneumonid subfamily Ctenopelmatinae (Scolobatinae sensu Townes 1970) and tribe Mesoleiini. The tribe is the most speciose and taxonomically difficult in the subfamily. Only a few genera have been studied in detail (Kaur 1989, Leblanc 1989, Viitasaari 1979). The Palearctic species of *Protarchus* were revised by Viitasaari (1979), who recognized four species and discussed the biology of the species that parasitize sawflies of the genus *Trichiosoma* (Cimbicidae) in bogs, based on extensive collecting and rearing. The Nearctic *Protarchus* were studied by Walley (1938), who recognized four species based on specimens in the Canadian National Collection.

Ichneumonids of the genus *Protarchus* are large sized, the nervellus in the hind wing is intercepted above its middle, the areolet is present, the clypeus is small and the medial dorsal carinae on the first metasomal tergite extend beyond the spiracles. Both Nearctic and Palearctic species parasitize *Trichiosoma* spp.

Study of the Nearctic and Palearctic specimens shows that the Nearctic *P. longipes* (Cushman) and the Palearctic *P. sorbi* (Ratzeburg) represent a single Holarctic

species. In addition, *P. testatorius* (Thunberg) is Holarctic but had not been reported for the Nearctic region by previous authors. The discovery of Holarctic distribution patterns and of two undescribed Nearctic species encouraged me to revise the Nearctic species of *Protarchus*.

MATERIALS, METHODS AND TERMINOLOGY

Material studied.—A total of 87 Nearctic specimens were examined from 5 collections as follows (collections acronyms are from Arnett and Samuelson (1986)): AEIC: American Entomological Institute, Gainesville, Florida, D.B. Wahl, 31 specimens; ANSP: Academy of Natural Sciences, Philadelphia, Pennsylvania, D. Azuma, 2 specimens; CNCI: Canadian National Collection of Insects, Ottawa, Ontario, J.R. Barron, 43 specimens; LLIC: Luc Leblanc private collection, Montréal, Canada, 1 specimen; USNM: National Museum of Natural History, Washington, D.C., B. Danforth, 10 specimens.

Morphological terms.—The morphological terms used in the descriptions are from Gauld (1984) except that mesosoma is used instead of thorax, and metasoma is used instead of gaster. Terms used to

characterize microsculpture are from Allen and Ball (1980). In characterizing metasomal punctures and sculpture, only the second tergum was utilized as sculpture is best defined on that segment.

Color descriptions.—Areas used to describe color patterns are as follows. Antennae are divided into dorsal and ventral surfaces and legs are divided into anterior, posterior, dorsal and ventral surfaces if imagined as stretched out horizontally at right angles from the body. Areas in bilaterally symmetrical parts (face, clypeus, epicnemium, dorsal and ventral surfaces of mesosoma and metasomal terga) are identified as median/lateral and basal/apical for face, clypeus and epicnemium, or median/apical and anterior/posterior for other parts. Areas in asymmetrical parts are identified as anterior/posterior and upper/lower.

Measurements.—A total of 37 females and 20 males were measured with an ocular micrometer. Length of the forewing was measured from the junction of costal vein with humeral plate to the most distant tip between the ends of veins Rs and M. Height of face is the distance between a line connecting the lower margins of antennal sockets and a line connecting the tentorial pits. Width of face is the distance between the inner margins of the compound eyes at the level of the middle of face height. Length of the first metasomal tergum was measured in lateral view from the base to the tip of its dorsal surface. Width of the first metasomal tergum was measured in dorsal view at its widest part near the apex. The length of the hind femur was measured on the anterior surface from the base to the apex. The width of the hind femur was measured at its mid length. The widths of the hind tibia and hind tarsomere 1 were measured at their widest part in lateral view.

Genus *PROTARCHUS* Foerster

Protarchus Foerster 1869:201. Type species: *Tryphon rufus* Gravenhorst (= *testatorius* Thun-

berg). Designated by Woldstedt 1877:460. Lectotype not examined.

Zacalles Foerster 1869:204. Type species: *Zacalles magnus* Davis. Designated by Davis 1898:283. Synonymized by Cushman 1924:8. Holotype examined.

Protarchoides Cushman 1922:25. Type species: *Protarchoides longipes* Cushman. Original designation. Synonymized by Townes 1945:505. Holotype examined.

Diagnostic characters.—Large (forewing 9.8 to 18.3 mm long). Clypeus (Fig. 3) small, transversely convex near base (near middle in *P. sorbi*), apically almost flat, and with apical margin truncate. Mandible short and broad, its upper tooth a little wider and longer than lower tooth (Fig. 4) or much wider than lower tooth (Fig. 5). Forewing with areolet usually present, large (Fig. 28) or very small (Fig. 29). Vestige of vein 1/Rs+M (= ramulus) often present (Fig. 29) (always absent in other genera of Mesoleiini). Vein cu-a separated from vein Rs+M by 0.2 to 0.5 of its length. Hind wing with vein 1/Cu longer than vein cu-a ("nervellus intercepted above middle"). Tibial spurs of middle and hind legs unequal, the longest spur about 0.3 to 0.4 as long as first tarsomere. First tergum moderately stout, with median dorsal carinae well defined and strong (Figs. 17,19), or reduced to a median furrow (Fig. 21) but always extending beyond spiracle. Terga 2 to 4 in some species each with two large sublateral swellings where punctures are sparser (Fig. 23). Hairs on female hypopygium directed backward.

Biology and biogeography.—Hosts of *Protarchus* are almost invariably larvae of *Trichiosoma* (Hymenoptera: Cimbicidae). Published host records for the Palearctic region are: *T. nanae* Vikberg & Viitasaari, parasitized by *P. testatorius* in Finland (Viitasaari 1979, Vikberg & Viitasaari 1991); *T. ?lucorum* L., parasitized by *P. testatorius* and *P. sorbi* in Finland (Viitasaari 1976, 1979). Records of *Palaeocimbex femorata*, parasitized by *P. testatorius* (Townes et al. 1965) and *Cimbex* parasitized by *P. heros*

(Holmgren 1876) would require confirmation. Label data included with Nearctic specimens indicate that *Trichiosoma triangulum* is attacked by *P. testatorius*, *P. sorbi* and *P. mellipes*. Bogs are the usual habitat of *Protarchus* spp. (Viitasaari 1979). *P. testatorius*, *P. sorbi* and *P. bolbogaster* release a strong odor when picked up, as indicat-

ed by label data. The species *P. sorbi* and *P. testatorius* are present in the boreal zone of North America (Figs. 31–32) as well as across the Palearctic region. The new species *P. atrofascies*, from Alaska, may also be Holarctic. The remaining three species, on the other hand, are apparently restricted to north-eastern North America.

KEY TO NEARCTIC SPECIES OF *PROTARCHUS*

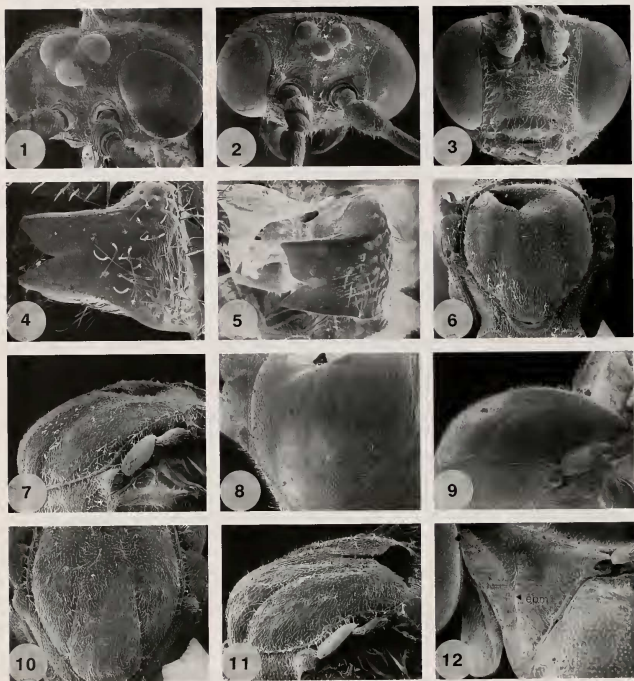
1. Hind tibiae entirely light colored, brown or yellowish brown; ocelli enlarged and hind ocelli separated by about their diameter (Fig. 1) 2
 - Hind tibiae apically to entirely dark, reddish black to black; ocelli smaller and hind ocelli separated by more than their diameter (Fig. 2) 4
2. Epomia clearly defined and prominent (Fig. 12); metasoma black or brownish black beyond tergum 2; size forewing 12.3–16.0 mm long 3
 - Epomia indistinct; metasoma generally mostly brown, but in some specimens black beyond tergum 2; forewing 16.5–18.3 mm long *magnus* (Davis)
3. Face black, or sometimes black with a yellowish brown median spot; mesosoma entirely black except light tegula; metasoma entirely black *mellipes* (Provancher)
 - Face brown or yellowish brown; mesosoma brownish black with extensive yellowish orange and brown markings; metasoma brownish black with tergum 1 and part of tergum 2 brown *pallidicornis* (Walley)
4. Metasomal terga black, with extensive orange on terga 2 to 4; areolet usually present and very small (Fig. 29) *testatorius* (Thunberg)
 - Metasomal terga entirely black; areolet large (Fig. 28) or absent 5
5. Metasomal terga 2 to 4 each with two large sublateral swellings (Fig. 22); upper mandibular tooth much wider than lower tooth (Fig. 5); hind tibia entirely black *bolbogaster* Leblanc, n. sp.
 - Metasomal terga 2 to 4 without sublateral swellings (Fig. 23); upper mandibular tooth subequal to lower tooth (Fig. 4); hind tibia basally yellow to orange and apically black ... 6
6. Notaulus weak and reduced to shallow impressions (Figs. 6,7); hind tibia of male black in apical 0.6; face of male yellow *sorbi* (Ratzeburg)
 - Notaulus anteriorly strong and sharply defined (as Figs. 8,9); hind tibia of male black in apical 0.5; face of male black except faint brown median spot (female unknown) *atrofascies* Leblanc, n. sp.

Protarchus atrofascies Leblanc, new species (Fig. 32)

Diagnostic combination.—Face $1.2 \times$ as wide as high (wider in other species), areolet absent, face of male black except faint light spot (female unknown), mesosoma and metasoma predominantly black.

Description.—**Structure.** Antenna with >20 flagellomeres (broken). Ocelli enlarged and sitting on a swelling, hind ocel-

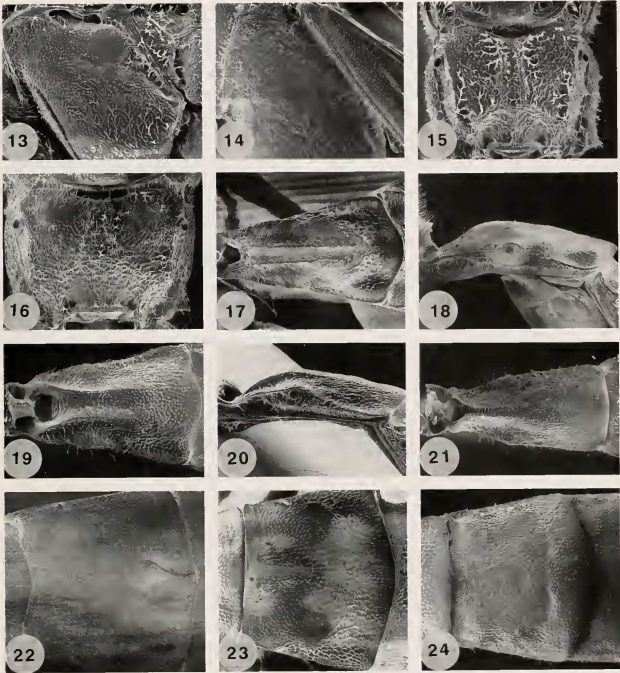
li separated by about their diameter. Antennal sockets in lateral view forming a moderately strong angle with vertical axis of compound eye. Frons not strongly depressed. Face $1.2 \times$ as wide as high. Median swelling of face moderate. Upper mandibular tooth subequal in size and shape to lower tooth. Notaulus strong and sharply defined only at anterior end of mesoscutum. Epomia weak. Mesopleuron separated by $0.5\text{--}2.0$ of their diameter and



Figs. 1-12. 1-2, head in dorsal view: 1, *P. magnus*; 2, *P. testatorius*. 3, face of *P. sorbi*. 4-5, mandibular teeth: 4, *P. testatorius*; 5, *P. bolbogaster*. 6-11, mesoscutum and notauli, dorsal and lateral: 6-7, *P. sorbi*; 8-9, *P. magnus*; 10-11, *P. testatorius*. 12, pronotum of *P. mellipes*, with epomia (EPM).

microsculpture with meshes well outlined and sculpticells convex; well defined on posterior 0.3 of mesopleuron below speculum and gradually fading towards other parts of mesepisternum. Carinae of propodeum strongly defined. Forewing 12.3 mm long, areolet absent. Hind femur 3.7 mm long and $6.2 \times$ as long as wide. Hind tarsomere 1 weakly compressed laterally

and $0.55 \times$ as wide as hind tibia near apex. First metasomal tergum $2.1 \times$ as long as wide, with median dorsal carinae reduced to a median furrow; in lateral view weakly and regularly curved at mid-length. Sublateral swellings on terga absent. Metasomal tergum 2 with punctures almost coalescent with outlines almost polygonal when close, and microsculpture



Figs. 13–24. 13–14, mesopleuron: 13, *P. sorbi*; 14, *P. bolbogaster*. 15–16, propodeum: 15, *P. sorbi*; 16, *P. testatorius*. 17–21, metasomal tergum 1, dorsal and lateral: 17–18, *P. bolbogaster*, 19–20, *P. sorbi*. 21, *P. testatorius*. 22–24, metasomal tergum 2, dorsal: 22, *P. magnus*; 23, *P. bolbogaster*; 24, *P. sorbi*.

well defined with sculpticells convex along posterior and lateral borders of tergum, at most suggested at centre of tergum and almost entirely faded anteriorly. **Coloration:** Antenna with scape, pedicel and flagellum black except traces of yellowish brown on flagellomeres 9 to 13. Head black except faint brown median spot on face below tubercle, brown clypeus

and brown anterior surfaces and apical third of lateral surfaces of mandibles. Mesosoma black. Wings with light yellow infuscation. Legs with all coxae and trochanters black. Femur, tibia and tarsus of all legs orange except apical half of hind tibia and whole hind tarsus black. Metasoma black.

Etymology.—From the Latin *ater* (black)

and *facies* (face), referring to the dark colored face.

Distribution.—Known only from the type locality (Fig. 32).

Specimen examined.—Holotype male: "Unalakleet, Alaska 8.viii.1961 R. Madge". Condition of type: missing left antenna beyond flagellomere 17 and right antenna beyond flagellomere 20. [CNCI].

***Protarchus bolbogaster* Leblanc,
new species**

(Figs. 5,14,17,18,23,30)

Diagnostic combination.—Upper mandibular tooth much wider than lower tooth (Fig. 5) (subequal in other species), sublateral swellings on metasomal tergites 2 to 4 (Fig. 22) (absent in other species), mesosoma and metasoma predominantly black.

Description.—**Structure**: Antenna with 48–53 flagellomeres. Ocelli of moderate size and not sitting on a swelling, hind ocelli separated by more than their diameter. Antennal sockets in lateral view forming a moderately strong angle with vertical axis of compound eye. Frons not strongly depressed. Face 1.7–1.8 (female) and 1.5–1.7 (male) $\times$ as wide as high. Median swelling of face moderate. Upper mandibular tooth much wider than lower tooth (Fig. 5). Notaulus strong and sharply defined to middle of mesoscutum. Epomia indistinct. Mesopleuron (Fig. 14) with punctures separated by 0.5–2.0 of their diameter and microsculpture with meshes lightly impressed and sculpticells slightly convex, but more convex anterior to speculum. Carinae of propodeum strongly defined. Forewing 13.6–15.2 (female) and 13.9–14.8 (male) mm long, areolet present and large. Hind femur 4.2–4.6 mm long and 5.2–6.2 $\times$ as long as wide. Hind tarsomere I weakly compressed laterally and 0.50 $\times$ as wide as hind tibia near apex. First metasomal tergum 1.8–2.1 $\times$ as long as wide, with median dorsal carinae well defined and strong (Fig. 17); in lateral view decurved with a strong angle before

midlength (Fig. 18). Terga 2 to 4 each with two large sublateral swellings with sparser punctures (Fig. 23). Metasomal tergum 2 (Fig. 23) with punctures almost coalescent with outlines polygonal, but sparser and faded on sublateral swellings, and microsculpture well defined along posterior and lateral borders, but with meshes much smaller and flat along anterior border. Dorsal notch on ovipositor with anterior margin without a strong angle, gradually sloping. **Coloration**: *Female*.—Antenna with scape and pedicel reddish black, and flagellum with flagellomeres dorsally reddish brown and ventrally brownish orange gradually turning reddish brown near apex. Head black except anterior surfaces and apical half of lateral surfaces of mandibles brown. Mesosoma black except tegulae yellowish brown. Wings with yellow infuscation. Legs orange except hind tibia and tarsus reddish black to black. Metasoma black. *Male*.—Antenna with scape and pedicel brown, and flagellum with flagellomeres dorsally reddish brown and ventrally brown. Head black except usually brown median longitudinal spot on face below tubercle, brown to reddish black clypeus and brown anterior surfaces and apical half of lateral surfaces of mandibles. Mesosoma black except tegulae yellowish brown. Wings with yellow infuscation. Legs orange except hind tibia and tarsus reddish black to black. Metasoma black.

Etymology.—From the Greek *bolbos* (swelling) and *gaster* (belly), referring to the characteristic sublateral swellings on metasomal terga 2 to 4.

Distribution.—Transcontinental in cold temperate and boreal regions (Fig. 30).

Specimens examined.—3 females and 6 males. *Holotype male*, "Estes Pk. Colo.[rado] 7500 ft 7 mi. E. 8-18-48 Evans"; "*Protarchus* Det. W.R.M. Mason '48". Condition of type: intact. [CNCI]. *Paratypes*: CANADA. BRITISH COLUMBIA: Jesmond, 14.ix.1938, J.K. Jacob (1F,CNCI); Racing River, 2400',

24.viii.1973, H.&M. Townes (1F,AEIC). ONTARIO: Orrville, 21.vii.1958, L.L. Pechuman (1M,AEIC). QUEBEC: Lac Roland, R.I.F. 41, specimen no. 12150-B (1M,CNCI). YUKON TERRITORY: 14 mi.E.Dawson, 1300', 30.vi.1962, R.E. Leech (1F,CNCI) (used for SEM). UNITED STATES. MAINE: Dryden, 30.viii.1959 (1M,AEIC); Roque Bluff, 10.viii.1907, J.A. Cushman, "*Protarchoides mandibularis*" Allotype # 25975, USNM (1M,USNM). MICHIGAN: Huron Mts, 25.viii.1959, H. Townes, "strong *Pimpla* odor" (1M,AEIC).

Remarks.—This species is closely related to the Palearctic *P. heros* (Holmgren), both species sharing as synapomorphies the unique mandible shape and the large sub-lateral swellings on terga 2 to 4. *P. bolbogaster* differs from *P. heros* by its predominantly orange legs. Cushman's original allotype of *P. mandibularis* belongs to *P. bolbogaster*.

***Protarchus magnus* (Davis)**

(Figs. 1,8,9,22,26,30)

Zaccas magnus Davis 1898 (1897):283.

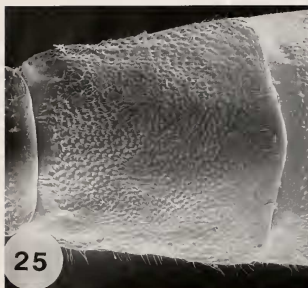
Diagnostic combination.—Whole body predominantly light colored (brown), hind tibiae entirely light colored, ocelli enlarged and hind ocelli separated by about their diameter, dorsal notch on ovipositor with anterior margin with strong angle, abruptly sloping (Fig. 26).

Description.—**Structure.**—Antenna with 47–48 flagellomeres. Ocelli enlarged and sitting on a swelling, hind ocelli separated by about their diameter (Fig. 1). Antennal sockets in lateral view forming a moderately strong angle with vertical axis of compound eye. Frons not strongly depressed (Fig. 1). Face 1.5–1.7 × as wide as high. Median swelling of face very weak. Upper mandibular tooth subequal in size and shape to lower tooth. Notaulus strong and sharply defined only at anterior end of mesoscutum (Fig. 8,9). Epomia weak. Mesopleuron with punctures separated by 0.5–2.0 of their diameter and microsculp-

ture with sculpticells very convex, making surface mat; meshes well outlined on posterior half below speculum, but gradually fading anteriorly. Carinae of propodeum strongly defined. Forewing 16.5–18.3 mm long, areolet present and large. Hind femur 4.6–5.2 mm long and 6.8–8.0 × as long as wide. Hind tarsomere 1 weakly compressed laterally and 0.50–0.55 × as wide as hind tibia near apex. First metasomal tergum 2.1–2.6 × as long as wide, with median dorsal carinae reduced to a median furrow; in lateral view weakly and regularly curved at midlength. Sub-lateral swellings on terga absent. Metasomal tergum 2 (Fig. 22) with punctures round and not coalescent, and microsculpture uniform over all tergum, with sculpticells convex. Dorsal notch on ovipositor with anterior margin with a strong angle, abruptly sloping (Fig. 26). **Coloration: Female.**—Body uniformly brown except the following. Yellowish brown parts are antennae, clypeus, mandibles, hind corner lobe of pronotum, tegula, subalar prominence, mesepimeron and legs beyond coxae. Black parts are base of first antennal flagellomere and narrow bands at apices of metasomal terga 3 to 8. Wings with yellow infuscation. Color variation: Some females have extensive black markings: frons, vertex and genae, propleuron, all pronotum except upper and posterior margins and hind corner lobe, dorsal surface of forecoxa, anteromedian band on mesoscutum to half of mesoscutum length and two bands on mesoscutum lateral to notauli, upper fourth of epicnemium, upper fourth to third of mesopleuron except anterior and posterior margins, subtegular ridge, speculum, mesosternum except anterolateral corners, large central spot on metasomal tergum 2 and whole metasoma beyond tergum 2.

Distribution.—Northeastern United States and Southeastern Canada (Fig. 30).

Specimens examined.—10 females. *Holotype* female, 4 labels, "N!N"; "HoloTYPE 4340"; "*Zaccas magnus* Davis"; "Collec-



Figs. 25–27. 25, *P. testatorius*, metasomal tergum 2, dorsal. 26–27, ovipositor: 26, *P. magnus*; 27, *P. sorbi*.

tion of THE ACADEMY OF NATURAL SCIENCES of Philadelphia. ANSP". Condition of type: missing left flagellum beyond flagellomere 11, right antenna, left fore wing; right fore and hind wings pinned below specimen. [ANSP]. *Other specimens*: CANADA. QUEBEC: Joliette Co., Ste-Béatrix, 24.VIII.1978 (1F,LLIC) (used for SEM). UNITED STATES. MICHIGAN: Midland, vii.1950 (1F,AEIC). NEW YORK: Allegany St.Pk., 30.vii.1938 (1F,USNM), 31.vii.1938 (1F,USNM), A.R. Shaddle; Essex Co., Keene Valley, 17.ix.1917, H. Nortman (1F,ANSP); Six Miles Creek, Ithaca, 17.vii.1947, J.G. Franclemont (3F,AEIC). PENNSYLVANIA: Glenside, "10.12.1929", G.G. Slesman (1F,USNM).

***Protarchus mellipes* (Provancher)**
(Figs. 12,31)

Coelocentrus mellipes Provancher 1886:113.

Protarchoides mellipes: Walley 1938:231.

Protarchoides pallipes Cushman 1927:15. Synonymy by Walley 1938:231.

Diagnostic combination.—*Epomia* clearly defined and prominent (Fig. 12), ocelli enlarged and hind ocelli separated by about their diameter, face entirely black, or at most with yellowish brown median spot,

mesosoma and metasoma almost entirely black, hind tibiae entirely light colored.

Description.—**Structure**: Antennal flagellum with 43–46 (female) and 41–43 (male) flagellomeres. Ocelli enlarged and sitting on a swelling, hind ocelli separated by about their diameter. Antennal sockets in lateral view forming a moderately strong angle with vertical axis of compound eye. Frons not strongly depressed. Face $1.5\text{--}1.7 \times$ as wide as high. Median swelling of face moderate. Upper mandibular tooth subequal in size and shape to lower tooth. Notaulus strong and sharply defined only at anterior end of mesoscutum. *Epomia* clearly defined and prominent (Fig. 12). Mesopleuron with punctures separated by $0.5\text{--}2.0$ of their diameter and microsculpture with sculpticells convex, making surface slightly mat; meshes well outlined on posterior half below speculum, but gradually fading anteriorly. Carinae of propodeum well defined and strong. Forewing $13.8\text{--}16.0$ (female) and $12.3\text{--}13.2$ (male) mm long. Areolet present and large. Hind femur $3.9\text{--}4.9$ mm long and $6.0\text{--}7.0 \times$ as long as wide. Hind tarsomere 1 weakly compressed laterally and $0.50\text{--}0.55 \times$ as wide as hind tibia near apex. First metasomal tergum $2.3 \times$ as long as

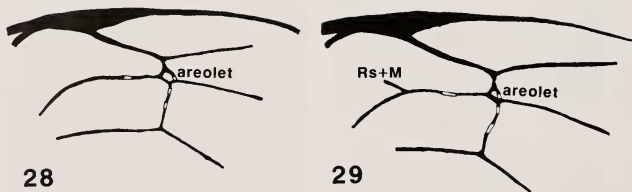
wide with median dorsal carinae reduced to a median furrow and; in lateral view weakly and regularly curved at mid-length. Sublateral swellings on terga absent. Metasomal tergum 2 with punctures round and not coalescent, and microsculpture uniform over all tergum with sculpticells convex. Dorsal notch on ovipositor with anterior margin without a strong angle, gradually sloping. **Coloration:** *Female*.—Antenna with scape and pedicel black or black with ventral surfaces yellowish orange, and flagellum with basal section yellowish orange, except basal half of first flagellomere and dorsal surfaces of first few flagellomeres generally black, and apical section black to brown. Head black except clypeus reddish brown to yellowish brown, lower margin of face along clypeus sometimes yellowish brown and mandibles black to yellowish brown. Mesosoma black except yellowish brown to reddish black tegula. Wings with yellow infuscation. Legs yellowish brown except fore, middle and hind coxae and usually fore, middle and hind trochanters 1 black, usually a narrow brownish orange longitudinal line on black dorsal surface of hind coxa and brownish orange fore and middle tarsomeres 5. Metasoma black. *Male*.—Antenna with scape and pedicel black, and flagellum with basal section yellowish orange, except dorsal surfaces of first few flagellomeres black and with apical section dark brown. Head black except clypeus yellowish brown and, in one specimen, faint traces of yellowish brown on face. Mesosoma black except tegula yellowish brown. Wings with yellow infuscation. Legs yellowish brown except fore, middle and hind coxae and trochanters 1 reddish black. Metasoma black.

Distribution.—Transcontinental in boreal region (Fig. 31).

Specimens examined.—5 females and 2 males. **Type material:** Lectotype of *Coelocentrus mellipes* Provancher, designated by Barron 1975:508; male, 6 labels: "Holotype

male *Coleocentrus mellipes* Provancher No. 4235"; "*Coleocentrus* n. spec!"; "G 484"; "This must be the type of *Coleocentrus mellipes* Prov. which g.[ahan] & R.[ohwer] could not locate. It was evidently returned to geddes by Prov. & the label [# 2] in red ink is in Geddes hand (note by G.S. Walley april/20/37)"; "Lectotype *Coleocentrus mellipes* Provancher Comeau '40"; "LECTOTYPE *Coleocentrus mellipes* Provancher G 484 Barron '71". Specimen from Rocky Mountains according to Walley, 1938. Condition of type: missing right fore and middle legs beyond coxae, left middle leg beyond tibia and both hind tarsi but tarsomeres 1–2 of one hind leg glued on first label. [CNCI]. Holotype of *Protarchoides pallipes* Cushman. Female. 3 labels: "Edmonton, Alberta 23.viii.1916 G. Salt"; "Type No. 40444 U.S.N.M."; *Protarchoides pallipes* Type. Cush.". Condition of type: missing entire left antenna and right hind tarsus; left hind tarsus broken and re-glued between tarsomeres 2 and 3. [USNM]. **Other specimens.** CANADA. ALBERTA: 15 mi.E.Morley, 14.viii.1962, K.C. Herrmann (1F,CNCI) (used for SEM); Edmonton, 23.VIII.1926, G. Salt, paratype # 40444, USNM (1F,USNM). BRITISH COLUMBIA: Houston, 17.vi.1959, Forest Insect Survey specimen no. 58-1792-0119, ex. *Trichiosoma triangulum* (1M,CNCI); Robson, 13.ix.1949, H.R. Foxlee (1F,CNCI). ONTARIO: Smoky Falls, near Kapuskasing, 9.viii.1937, R.V. Whelan (1F,CNCI).

Remarks.—The specimen used by Provancher, collected by G. Geddes in the Rocky Mountains (Provancher 1886), could not be located by Rohwer in his 1915 visit to the Provancher collection (Gahan and Rohwer 1917, Cushman and Rohwer 1920). Walley (1938) discovered a specimen in the Geddes collection, donated to CNCI, labelled "*Coleocentrus* n sp" and agreeing with Provancher's description. He accepted this specimen as the one originally used by Provancher. Barron (1975) designated the specimen as lectotype.



Figs. 28–29. Forewing, showing areolet: 28, *P. sorbi*; 29, *P. testatorius*.

***Protarchus pallidicornis* (Walley)**

(Fig. 30)

Protarchoides pallidicornis Walley, 1938:231.

Diagnostic combination.—*Epomia* clearly defined and prominent (Fig. 12), ocelli enlarged and hind ocelli separated by about their diameter, face entirely brown or yellowish brown, mesosoma and metasoma predominantly brownish black with extensive yellowish orange and brown markings, hind tibiae entirely light colored.

Description.—**Structure:** Antenna with 45 (female) flagellomeres. Ocelli enlarged and sitting on a swelling, hind ocelli separated by about their diameter. Antennal sockets in lateral view forming a moderately strong angle with vertical axis of compound eye. Frons not strongly depressed. Face $1.5 \times$ as wide as high. Median swelling of face moderate. Upper mandibular tooth subequal in size and shape to lower tooth. Notaulus strong and sharply defined only at anterior end of mesoscutum. *Epomia* clearly defined and prominent. Mesopleuron with punctures separated by $0.5\text{--}2.0$ of their diameter apart and microsculpture with sculpticells convex, making surface slightly mat and meshes well outlined on posterior half below speculum, but gradually fading anteriorly. Carinae of propodeum strongly defined. Forewing 14.5 (female) and 12.8 (male) mm long, areolet present and large. Hind femur 4.3 (female) and 4.7 (male)

mm long and 6.9 (female) and 7.8 (male) $\times$ as long as wide. Hind tarsomere 1 weakly compressed laterally and $0.50 \times$ as wide as hind tibia near apex. First metasomal tergum $2.4 \times$ as long as wide, with median dorsal carinae reduced to a median furrow; in lateral view weakly and regularly curved at midlength. Sublateral swellings on terga absent. Metasomal tergum 2 with punctures round and not coalescent, and microsculpture uniform over all tergum with sculpticells convex. Dorsal notch on ovipositor with anterior margin without a strong angle, gradually sloping. **Coloration:** *Female.*—Antenna brownish orange except dorsal half of scape brownish black. Head brown except frons, area around ocelli and vertex behind ocelli brownish black. Mesosoma brownish black except the following. Yellowish orange parts are hind corner lobe of pronotum, tegula, subalar prominence, anterior margin of mesopleuron, mesepimeron and upper division of metapleuron. Brown parts are sublateral longitudinal bands on mesoscutum along notauli from anterior margin to three quarters of scutum length and lateral bands along mesoscutum margin from wing tegula to end of mesoscutum, lower half of epicnemium, anterolateral corner of mesosternum, lower margin of mesopleuron, speculum, scutellum including axillae, postscutellum, upper anterior corner of metapleuron, anterior half of area lateralis of pronotum and along median furrow of propodeum. Wings

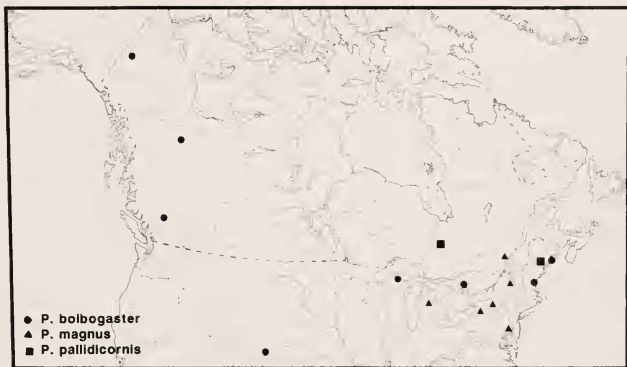


Fig. 30. Distribution of *P. bolbogaster* (circles), *P. magnus* (triangles) and *P. pallidicornis* (squares).

with yellow infuscation. Legs yellowish brown except faint traces of brownish black on dorsal surface of forecoxa and apical half of dorsal surfaces of mid and hind coxae. Metasoma brownish black except first tergum brown and faint traces of brown on second tergum. *Male*.—Antenna with scape and pedicel dorsally brownish black and ventrally yellowish brown, and flagellomere 1 yellowish brown (rest of antennae missing). Head brownish black except face, clypeus, malar space and mandibles yellowish brown. Mesosoma brownish black except the following. Yellowish orange parts are hind corner lobe of pronotum, tegula, subalar prominence and mesepimeron. Brown parts are two sublateral longitudinal bands on mesoscutum along notauli from anterior margin to three quarters of scutum length and two lateral bands along margins of scutum from base of sublateral band to three quarters of scutum length, lower two thirds of epicnemium, anterolateral corner of mesosternum, lower margin of mesopleuron, speculum, scutellum including axillae, postscutellum and entire propodeum ex-

cept faint brownish black on metapleuron. Wings with yellow infuscation. Legs yellowish brown. Metasoma brownish black except first tergum and basal half of second tergum brown and faint brown traces on anterolateral corners of third tergum.

Distribution.—Ontario, Maine (Fig. 30).

Specimens examined.—1 female and 1 male. *Holotype*, examined, female, 2 labels: "Holotype female *Protarchoides pallidicornis* Walley No. 4410"; "Smokey Falls, Ont[ario] (near Kapuskasing) Aug 4, 1937 R.V. Whelan". Condition of type: missing hind tarsomeres 4–5. [CNCI]. *Other specimen*. UNITED STATES. MAINE: Glenburn, 5.vii.1928, Gypsy moth Lab, 10088 NIG, ex. Tenthredinid (!) (1M,USNM).

Remarks.—This species is closely related to *P. mellipes*. The prominent epomia (Fig. 12) is a synapomorphy.

Protarchus sorbi (Ratzeburg)

(Figs. 3,6,7,13,15,19,20,24,27,28,31)

Tryphon sorbi Ratzeburg 1844:126. Holotype lost.

Psilosarge (!) *longipes* Ashmead, in Slosson 1902: 321 (*nomen nudum*).

Protarchoides longipes Cushman 1922:26. *Protarchus longipes*: Townes, 1945:505. NEW SYNONYM.

Protarchoides mandibularis Cushman 1924:9. Designated synonym to *P. longipes* by Townes 1945:505. NEW SYNONYM.

Diagnostic combination.—Hind tarsomere 1 strongly compressed laterally and 0.55–0.70 as wide as hind tibia near apex, metasomal tergum 1 decurved with a strong angle (Fig. 20), face of male yellow, mesosoma and metasoma predominantly black.

Description.—**Structure.** Antenna with 36–45 flagellomeres. Ocelli of moderate size and not sitting on a swelling, hind ocelli separated by more than their diameter. Antennal sockets in lateral view forming a moderately strong angle with vertical axis of compound eye. Frons not strongly depressed. Face (Fig. 3) 1.6–1.9 × as wide as high. Median swelling of face almost absent. Upper mandibular tooth subequal in size and shape to lower tooth. Notaulus weak and reduced to shallow impressions (Figs. 6,7). Epomia indistinct or very weak. Mesopleuron (Fig. 13) with punctures separated by less than 0.1 of their diameter and microsculpture variable in different specimens from absent over all mesopleuron to almost absent with meshes absent to lightly convex below speculum to irregularly striated through fusion of sculpticells on posterior 0.5 of mesopleuron below speculum. Carinae of propodeum strongly defined (Fig. 15). Forewing 9.9–13.9 (female) and 9.8–12.5 (male) mm long, areolet present and large (Fig. 28). Hind femur 2.8–3.9 mm long and 5.2–6.5 × as long as wide. Hind tarsomere 1 strongly compressed laterally and 0.55–0.70 × as wide as hind tibia near apex. First metasomal tergum 1.4–1.9 × as long as wide, with median dorsal carinae well defined and strong (Fig. 19) or reduced to a median furrow; in lateral view decurved with a strong angle before mid-length (Fig. 20). Sublateral swellings on terga absent. Metasomal tergum 2 (Fig. 24)

with punctures very dense, polygonal, crater-like but not coalescent, and microsculpture with sculpticells convex along posterior border of tergum, otherwise completely faded on the rest of tergum. Dorsal notch on ovipositor with anterior margin without a strong angle, gradually sloping (Fig. 27). **Coloration:** *Female.*—Antenna with scape and pedicel black, and flagellum with flagellomeres dorsally brownish black and ventrally brownish orange and gradually turning brownish black near apex, or sometimes entire flagellum brownish black. Head black except anterior surface of mandible to entire mandible yellowish orange, and clypeus brownish orange to reddish black or black. Mesosoma black except hind corner lobe of pronotum and tegula reddish brown. Wings hyaline. Legs orange except sometimes traces of reddish black anteriorly at base of each coxae, and apical two thirds to nine tenths of hind tibia and whole hind tarsus reddish black or black. Metasoma black. *Male.*—Antenna with scape and pedicel reddish black except usually yellow ventral surface of scape and sometimes yellow ventral surface of pedicel, and flagellum with flagellomeres dorsally brownish black and ventrally brownish black to brownish orange. Head black except orbits between compound eyes and antennal sockets yellow, and face, clypeus and mandibles yellow. Mesosoma black except tegula yellow. Wings hyaline. Legs orange except apical six tenths of hind tibia and whole hind tarsus reddish black or black and sometimes yellow fore and middle coxae, fore, middle and hind trochanters, foretibia, foretarsus and basal half of middle tibia. Metasoma black.

Distribution.—Palearctic (Sweden, Finland, Russia) and transcontinental in North America (Fig. 31).

Specimens examined.—17 females and 14 males. Type material. *Holotype* of *Protarchoides longipes* Cushman. Female. 5 labels: "MT.WASH'[ingto]N."; "39"; "Type No.

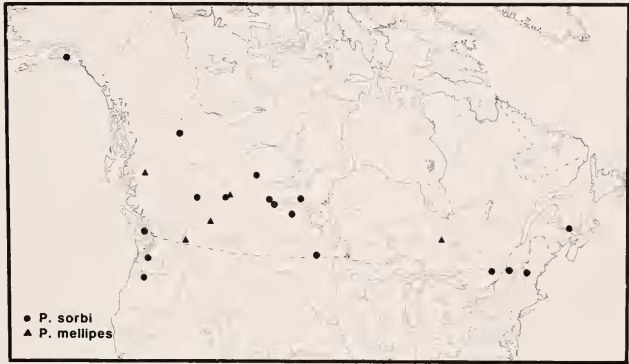


Fig. 31. Distribution of *P. sorbi* (circles) and *P. mellipes* (triangles).

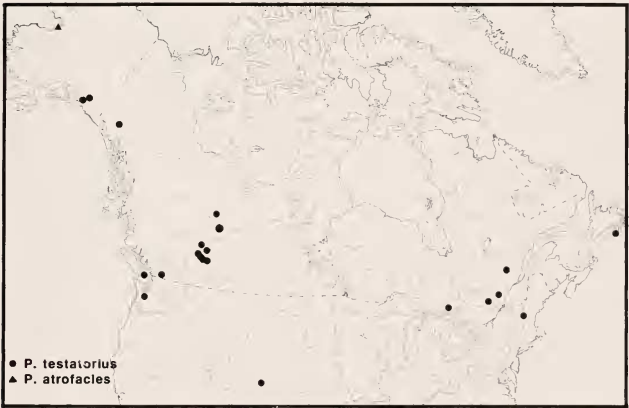


Fig. 32. Distribution of *P. testatorius* (circles) and *P. atrofacies* (triangles).

25030 U.S.N.M."; "*Psilosage longipes* - Type Ashm[ead]"; "*Protarchoides longipes* Type. Cush.". [New Hampshire, A.T. Slosson, 1902]. Condition of type: missing left hind tarsus; both antennae broken and glued on first label. [USNM]. *Holotype* of *Protarchoides mandibularis* Cushman. Female. 4 labels: "Wellington B.C. 28.VII.[19]04"; "1260"; "Type No 25975 U.S.N.M."; "*Protarchoides mandibularis* Type. Cush.". Condition of type: missing: left antenna beyond flagellomere 7, right antenna beyond flagellomere 37, right foreleg tarsus beyond tarsomere 1 and right hind leg tarsus beyond tarsomere 1; right antenna section containing flagellomeres 4 to 37 and right hind leg beyond coxa broken and glued on locality label. [USNM]. *Other specimens*: CANADA. ALBERTA: Edmonton, 28.vii.1926, E.H. Strickland (1M,AEIC); Entranse, emerged 21.iii.1950, Forest Insect Survey specimen no. A113313, ex. *Trichiosoma* sp. (1M,CNCI). BRITISH COLUMBIA: Summit Lake, Mile 392, Alaska Hwy, 4600', 16.vii.1959 (1F,CNCI), 4700', 15.vii.1959 (1F,CNCI), 5000', 6.vii.1959 (1M,CNCI); Stone Mtn Nat. Pk., "3800', 12.vii.1975, 13.vii.1973, 18.vii.1973, 20.vii.1973 (7M,AEIC). MANITOBA: Christopher Lake, emerged 4.iii.1963, Forest Insect Survey specimen no. 1914(02), ex. *Trichiosoma triangulum* (1F,CNCI); Turtle Mtn., 21.vii.1953, Brooks-Kelton (1F,CNCI); Wanless, 29.vi.1961, H.E. Mil-liron (1F,CNCI). PRINCE EDWARD ISLAND: Alberton, 15.vii.1940, G.S. Walley (1F,CNCI). QUEBEC: Hemmingford, 1.vii.1928, G.H. Hammond (1F,CNCI); Aylmer, 20.v.1920, G.H. Hammond, ex. *Trichiosoma* sp. (1M,CNCI). SASKATCHEWAN. Buffalo Narrows, emerged 4.iii.1964, Forest Insect Survey specimen no. 63W-2241(03), ex. *Trichiosoma triangularis* (!) (1F,CNCI); Candle Lake, emerged 10.ii.1951, Forest Insect Survey specimen no. W50-42786, ex. *Trichiosoma triangulum* (1M,CNCI); Parr Hill, emerged 17.ii.1961, Forest Insect Survey specimen no. W61-2392(04), ex. *Trichiosoma triangulum*

(1F,CNCI); Waskesiu, 21.vi.1938, J.G. Rempel (1F,AEIC). UNKNOWN PROVINCE: Crimson Lake, emerged before 12.vii.1961, Forest Insect Survey specimen no. 60A1409-03, ex. *Trichiosoma* sp. (1F,CNCI) (used for SEM). UNITED STATES. ALASKA: Seaward, <300', 25.vii.1951, W.J. Brown (1F,CNCI). OREGON: Mt. Hood, 3500', 19.vii.1978, 24.vii.1978, H.&M. Townes (2F,AEIC). WASHINGTON: Mt. Rainier, 4200', 15.vii.1940, H.&M. Townes, "odor like *Pimpla*" (1M,AEIC). UNKNOWN LOCALITY. Reared specimen labelled "99 88281" (1M,CNCI).

Protarchus testatorius (Thunberg)
(Figs. 2,4,10,11,16,21,25,29,32)

Ichneumon testatorius Thunberg 1822:276. Lectotype (designated by Roman, 1912) not examined.

Tryphon rufus Gravenhorst 1829:200. Holotype lost.

Mesoleius (Protarchus) melanurus Thomson 1895: 2020. Leptotype designation and synonymy by Viitasaari 1979:34. Lectotype not examined.

Diagnostic combination.—Areolet very small or sometimes absent (Fig. 29), metasoma black with extensive orange markings on tergites 2 to 4.

Description.—**Structure**: Antenna with 40–44 flagellomeres. Ocelli of moderate size and not sitting on a swelling, hind ocelli separated by more than their diameter (Fig. 2). Antennal sockets in lateral view forming a very strong angle with vertical axis of compound eye. Frons strongly depressed (Fig. 2). Face 1.3–1.4 × as wide as high. Median swelling of face moderate. Upper mandibular tooth subequal in size and shape to lower tooth (Fig. 4). Notauli strong and sharply defined to middle of mesoscutum length (Figs. 10,11). Epomia indistinct. Mesopleuron with punctures separated by 0.5–2.0 of their diameter and microsculpture generally absent, at most expressed as slightly convex sculpticells below speculum. Ca-

rinae of propodeum weakly defined to almost absent (Fig. 16). Forewing 11.2–13.3 mm long. Areolet in forewing very small (Fig. 29) or sometimes absent. Hind femur 3.6–4.4 mm long and $6.0\text{--}6.8 \times$ as long as wide. Hind tarsomere 1 weakly compressed laterally and $0.45\text{--}0.50 \times$ as wide as hind tibia near apex. First metasomal tergum $1.8\text{--}2.2 \times$ as long as wide, with median dorsal carinae reduced to a median furrow (Fig. 21); in lateral view weakly and regularly curved at mid-length. Sublateral swellings on terga absent. Metasomal tergum 2 (Fig. 25) with punctures very dense, slightly polygonal but not coalescent, but density decreasing towards posterior margin, and with microsculpture well defined on apical 0.3, flat in middle 0.3 and completely faded basally. Dorsal notch on ovipositor with anterior margin without a strong angle, gradually sloping. **Coloration: Female.**—Antenna with scape and pedicel reddish black, and flagellum brownish orange except basal portion of flagellomere 1 reddish black and dorsal surfaces of first few flagellomeres reddish black gradually turning brownish orange to yellowish orange near apex. Head black except the following. Yellow parts are orbits between eyes and antennal sockets, clypeus, mandibles and face except narrow median reddish black line below tubercle. Brownish orange parts are genal orbits from posterior ocelli down to two thirds to a quarter of eye height. Mesosoma black except the following. Yellow parts are tegula, scutellum, postscutellum and often four small spots on anterior margin of mesoscutum on the sides of notauli. Wings with light yellow infuscation. Legs with coxae black except anteromedian line on or whole anterior surface of forecoxa yellow and anteroapical spot on middle coxa yellow. Trochanters 1 black except anterior surface of foretrochanter 1 and apex of dorsal surface of middle trochanter 1 yellow. Fore and middle legs beyond trochanters 1 yellowish orange except ventral basal

quarter to half of middle femur reddish black. Hind trochanter 2 yellowish orange. Hind femur black except yellowish orange at base and apex. Hind tibia with basal 0.6 yellowish orange and apical 0.4 reddish black. Hind tarsi yellowish orange to brownish orange. Metasoma black with the following brownish orange: apical 0.25 of tergum 1, apical 0.33 to 0.5 of tergum 2 to entire tergum 2 except lateral black markings on basal 0.5, entire tergum 3 except sometimes a large median black spot, basal 0.15 of tergum 4 with a small subapical spot to entire tergum 4 except apical 0.1. **Color variations:** Two females have brownish orange markings on propodeum anterior to postpectal carina and lateral to median furrow and extending laterally below lateral carinae. These markings are present in most Palearctic specimens of *P. testatorius*.

Distribution.—Palearctic (Sweden, Finland, Germany, Russia) and transcontinental in North America (Fig. 32).

Remarks.—The lectotypes from Europe have not been examined because a good series of Palearctic material (AEIC, USNM) was studied and found to be conspecific with the Nearctic material.

Specimens examined.—28 females. ALBERTA: Banff, 18.viii.1946, E.H. Strickland (1F,AEIC); Banff, Black's Camp Ground, emerged 28.vi.1958, Forest Insect Survey specimen no. 58A108-03, ex. *Trichiosoma* sp. on alder (1F,CNCI); Cameron Lake, 9.vii.1949, C.P. Alexander (1F,AEIC); Canyon Creek, emerged 9.iii.1953, Forest Insect Survey specimen no. A2182A, ex. *Trichiosoma* sp. (1F,CNCI); Eisenhower Junction, Banff National Park, 9.viii.1962, K.C. Hermann (1F,CNCI); Fawcett, emerged 9.vii.1956, Forest Insect Survey specimen no. 55A1438-12, ex. *Trichiosoma* sp. (1F,CNCI); Kanamaskis, emerged 23.ii.1949, Forest Insect Survey specimen no. A-455-K, ex. *Trichiosoma* sp. (1F,CNCI); Lake Louise, 5600', 26.vii.1938, G.S. Walley (1F,CNCI); Nordegg, 21.vii.1926, E.H. Strickland (1F,CNCI); 18 mi.W. Strachan,

emerged 24.iii.1959, Forest Insect Survey specimen no. 58A1821-02, ex. *Trichiosoma* sp. (1F,CNCI). BRITISH COLUMBIA: Hope Mts, 20.viii.1931, A.N. Gartrell (1F,CNCI) (used for SEM); Saanich, emerged 23.v.1958, Forest Insect Survey specimen no. 58-3-01-A, ex. *Trichiosoma triangulum* (1F,CNCI). ONTARIO: Sudbury, 1891 (1F,CNCI). QUEBEC: Lac St-Jean, 20.viii.1939, P.L. Mercier (1F,AEIC); Kazabazua, 28.viii.1928, G.H. Fisk (1F,CNCI); Ste-Agathe des Monts, 7.viii.1937, G.S. Walley (1F,CNCI). YUKON TERRITORY: Whitehorse, 7.viii.1948, W.R. Mason (1F,CNCI). UNKNOWN PROVINCE: Hot Springs Road, 2.viii.1902, N.B. Sanson (1F,CNCI). FRANCE. Miquelon Island, 15.viii.1990, D. Abraham, collected in bog (1F,CNCI). UNITED STATES. ALASKA: Thompson Pass, 14.viii.1973, H.&M. Townes (1F,AEIC); Tsaina River, 17.viii.1973, 18.viii.1973, H.&M. Townes (2F,AEIC). COLORADO: Gould, 5.viii.1974, 6.viii.1974, H.&M. Townes (3F,AEIC). NEW HAMPSHIRE: Franconia (1F,USNM). WASHINGTON: Mt. Rainier, 22.vii.1940, H.&M. Townes, "strong *Pimpla odor*" (2F,AEIC).

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